

923 S.W.2d 549 (1995)**E.I. du PONT de NEMOURS AND COMPANY, INC., Petitioners,****v.****C.R. ROBINSON and Shirley Robinson, Respondents.**No. 94-0843.**Supreme Court of Texas.**

Argued February 7, 1995.

Decided June 15, 1995.

Rehearing Overruled July 8, 1996.

550 *550 Michael A. Hatchell, Tyler, Pamela Stanton Baron, Austin, Larry E. Cotten, Fort Worth, David A. Lowrance, Fort Worth, for petitioners.

William W. Kilgarlin, Santa Fe, NM, Jack Sanders, Jr., Marshall, Wayne Fisher, Houston, David W. Holman, Houston, Charles D. Kennedy, Arlington, for respondents.

GONZALEZ, Justice, delivered the opinion of the Court, in which PHILLIPS, Chief Justice, and HECHT, ENOCH and OWEN, Justices, join.

In this products liability case we determine the proper standard for the admission of scientific expert testimony under Rule 702 of the Texas Rules of Civil Evidence. The trial court excluded the testimony of an expert witness upon finding his opinions not scientifically reliable. The court of appeals reversed, holding that once a proponent establishes a witness's qualifications, the weight to be given the testimony and the credibility of the witness is to be determined by the trier of fact. 888 S.W.2d 490, 492. We hold that Rule 702 requires expert testimony to be relevant and reliable. Because the proponent of the testimony in this case failed to establish that the proffered testimony was scientifically reliable, the trial court did not abuse its discretion by excluding the expert witness. Accordingly, we reverse the judgment of the court of appeals and affirm that of the trial court.

I.

551 C.R. and Shirley **Robinson** sued **E.I. du Pont de Nemours** and Company (DuPont) for *551 products liability, breach of warranty, and violations of the Texas Deceptive Trade Practices-Consumer Protection Act (DTPA). TEX.BUS. & COMM.CODE §§ 17.41-17.63. The Robinsons asserted that the application of Benlate 50 DF, a fungicide manufactured by DuPont, which they claim was contaminated, damaged their pecan orchard.

The Robinsons' sole expert witness on causation was Dr. Carl Whitcomb. Dr. Whitcomb has a Bachelor of Science degree from Kansas State University and masters and doctorate degrees from Iowa State University in horticulture, plant ecology, and agronomy. From 1972 until 1985, Dr. Whitcomb taught and researched at Oklahoma State University. Since 1985, Dr. Whitcomb has engaged in consulting work for nurseries, greenhouses, and corporations. He has written numerous books and articles on horticultural topics. Dr. Whitcomb is also on the review board of *The Journal of Environmental Horticulture*, and he reviews articles proposed for publication in *The American Society of Horticultural Science*.

Dr. Whitcomb opined that Dupont contaminated Benlate during its manufacturing process with many things, including sulfonylurea (SU) herbicides, and that the application of contaminated Benlate damaged the Robinsons' pecan trees. One basis for his opinion was his inspection of the Robinsons' orchard in September 1992, conducted at the request of their attorney. Dr. Whitcomb visited the orchard and conducted an inspection that lasted two and a quarter hours. He visually scanned the orchard, which consists of about two hundred trees, and viewed approximately forty to fifty trees (25%)

closely. He "dug up roots" on some of the trees and took random pictures of a few trees that exemplified what he was "trying to show." At his deposition, Dr. Whitcomb conceded that there was no consistent pattern of damage to the trees. He did not conduct any soil or tissue testing, did not research relevant weather conditions, and did not test any of the Benlate used by the Robinsons, even though they had one opened box of the fungicide remaining. At the time of his deposition, Dr. Whitcomb had not visited any other pecan orchards for the purpose of investigating for Benlate damage.

On October 3, 1992, Dr. Whitcomb reported his findings to the Robinsons' attorney. He based his opinion that contaminated Benlate damaged the Robinsons' pecan trees on a method called *comparative symptomology*: because the Robinsons' pecan trees exhibited symptoms common to other plants treated with allegedly contaminated Benlate under dissimilar growing conditions, Benlate, the only common factor among all the plants, caused the damage.

Another basis for Dr. Whitcomb's opinion was an experiment he conducted in 1992, at the request of an attorney in Florida who represented clients asserting claims similar to the claims asserted by the Robinsons. In this study, Dr. Whitcomb applied several different concentrations and amounts of Benlate to groups of small plants in a controlled environment designed to replicate growing conditions in Florida. He maintained one control group of plants that was not treated with Benlate. Each plant was grown under identical soil, watering, lighting, and temperature conditions. Dr. Whitcomb carefully monitored the plants and observed particular symptoms common to plants and trees treated with Benlate, such as stunted growth and abnormal leaf coloring. Based on these symptoms, Dr. Whitcomb concluded that the Benlate applied to the plants in his study must have been contaminated. Dr. William Warde, a professor of statistics at Oklahoma State University, analyzed the results of Dr. Whitcomb's study. Dr. Warde concluded that the probability of Dr. Whitcomb's results being correct was ninety-nine percent.

Another basis for Dr. Whitcomb's opinion was a laboratory analysis of ten boxes of Benlate (none of which were used by the Robinsons). The tests revealed that out of eighteen substances found in the Benlate samples, only five were common to all boxes. *The tests did not reveal the presence of SU contaminants.* At his deposition, Dr. Whitcomb conceded that, if present, the SU contaminants in the tested Benlate were below scientifically detectable levels, and that he did not know at what level or concentration SU herbicides would damage pecan trees. *552 He also admitted that, if free of contamination, Benlate was a good product.

Dr. Whitcomb also based his opinion on a review of reports of other plants treated with SU herbicides and one study involving the application of Benlate to cucumber plants. Lastly, Dr. Whitcomb relied upon some internal DuPont documents which concerned other claims against the company for damages caused by allegedly contaminated Benlate and a recall of several batches of Benlate due to contamination by the herbicide atrazine.

After deposing Dr. Whitcomb, DuPont filed a motion to exclude his testimony, alleging among other things that his opinions were speculative and unreliable. The trial court held a pretrial hearing on DuPont's motion and found that Dr. Whitcomb's testimony:

- (1) was not grounded upon careful scientific methods and procedures;
- (2) was not shown to be derived by scientific methods or supported by appropriate validation;
- (3) was not shown to be based on scientifically valid reasoning and methodology;
- (4) was not shown to have a reliable basis in the knowledge and experience of his discipline (horticulture);
- (5) was not based on theories and techniques that had been subjected to peer review and publication;
- (6) was essentially subjective belief and unsupported speculation;
- (7) was not based on theories and techniques that the relevant scientific community had generally accepted; and
- (8) was not based on a procedure reasonably relied upon by experts in the field.

Based on these findings, the trial court excluded Dr. Whitcomb's testimony, concluding that it was not reliable and would not fairly assist the trier of fact in understanding a fact in issue in the case.

The parties agreed to try the case to the court, with the stipulation that in the event of a reversal, it would be tried the second time to a jury. At the nonjury trial, the Robinsons again sought to introduce Dr. Whitcomb's testimony. The trial court abided by its earlier ruling and excluded it. The Robinsons then offered a bill of exception containing Dr. Whitcomb's testimony. The trial court granted DuPont's motion for a directed verdict. The Robinsons appealed the judgment, claiming that the trial court had abused its discretion by excluding their expert testimony.

The court of appeals reversed and remanded the case for a new trial. 888 S.W.2d at 493. The court of appeals reviewed the trial court's Rule 702 inquiry in light of the following standards:

- (1) A body of scientific, technical, or other specialized knowledge must exist that is pertinent to the facts in issue;
- (2) The witness must have sufficient experiential capacity in his field of expertise. This capacity encompasses knowledge, skill, experience, training, and education;
- (3) The facts evaluated must be within the witness' field of specialized knowledge.

Id. at 492 (quoting *Guentzel v. Toyota Motor Corp.*, 768 S.W.2d 890, 897 (Tex.App.—San Antonio 1989, writ denied)). The court of appeals concluded that the trial court abused its discretion by excluding the expert testimony since DuPont had not contested Dr. Whitcomb's qualifications, only the methodology and research upon which he based his opinions. *Id.* at 492. The court of appeals further held that the jury was to determine the weight to be given Dr. Whitcomb's testimony and his credibility as an expert witness. *Id.* at 493 (citing *First City Bank-Farmers Branch v. Guex*, 659 S.W.2d 734, 739 (Tex.App.—Dallas 1983), aff'd, 677 S.W.2d 25 (Tex.1984)).

II.

A.

As numerous courts and commentators have observed, the use of expert witnesses in litigation has become widespread. See, e.g., *In re Air Crash Disaster*, 795 F.2d 1230, 1234 (5th Cir.1986) (observing that "the professional expert is now commonplace"); 2 GOODE ET AL., GUIDE TO THE TEXAS RULES OF EVIDENCE: CIVIL AND CRIMINAL § 702.2, at 17 (Texas Practice, 2d ed. 1993); Richey, *Proposals *553 to Eliminate the Prejudicial Effect of the Use of the Word "Expert" Under the Federal Rules of Evidence in Civil and Criminal Jury Trials*, 154 F.R.D. 537, 540 (1994) (noting an increase in the use of expert witnesses and in the services available to assist attorneys in locating them); Forinash, Comment, *Analyzing Scientific Evidence: From Validity to Reliability with a Two-Step Approach*, 24 St. MARY'S L.J. 223, 251 & n. 130 (1992) (stating that the "number of professional expert witnesses has increased" since expert testimony is "almost indispensable" in contemporary trials). In addition, the scientific theories about which these experts often testify have increased in complexity and have become more crucial to the outcome of the case. Black et al., *Science and the Law in the Wake of Daubert: A New Search for Scientific Knowledge*, 72 TEX.L.REV. 715, 801 (1994). These developments pose a difficult problem for trial judges ruling on the admissibility of an expert's testimony, which one commentator has described as follows:

In the past decade courts have faced the difficult task of ruling on the admissibility of evidence derived from a wide range of newly ascertained or applied scientific principles. Neutron activation analysis, sound spectrometry (voice prints), psycholinguistics, atomic absorption, remote electromagnetic sensing, and bite mark comparisons are but a sample of the kinds of scientific evidence inundating the courts.

Giannelli, *The Admissibility of Novel Scientific Evidence: Frye v. United States, a Half-Century Later*, 80 Colum.L.Rev. 1197, 1198 (1980) (footnotes omitted).

Professional expert witnesses are available to render an opinion on almost any theory, regardless of its merit. Chaulk v. Volkswagen of Am., Inc., 808 F.2d 639, 644 (7th Cir.1986) (quoting Keegan v. Minneapolis & St. Louis R.R., 76 Minn. 90, 78 N.W. 965, 966 (1899)) (observing that almost anything, no matter how absurd, can "be proved by some so-called `experts'"). While many of these experts undoubtedly hold reliable opinions which are of invaluable assistance to the jury, there are some experts who "are more than willing to proffer opinions of dubious value for the proper fee." 2 Goode, *supra*, § 702.2, at 17; see Havner v. E-Z Mart Stores, Inc., 825 S.W.2d 456, 465-66 (Tex.1992) (Cornyn, J., dissenting) (noting the "corrupting influence" of the use of experts who are paid to conduct an investigation and render an opinion in a case).

Expert witnesses can have an extremely prejudicial impact on the jury, in part because of the way in which the jury perceives a witness labeled as an expert. "[T]o the jury an `expert' is just an unbridled authority figure, and as such he or she is more believable." *Richey*, 154 F.R.D. at 544. A witness who has been admitted by the trial court as an expert often appears inherently more credible to the jury than does a lay witness. See *id.* at 545. Consequently, a jury more readily accepts the opinion of an expert witness as true simply because of his or her designation as an expert.

Added to the potentially prejudicial influence of the term expert is the difficulty inherent in evaluating scientific evidence. Jurors are often expected to understand complex testimony regarding arcane scientific concepts and are even asked to resolve issues on which the experts cannot agree. Brock v. Merrell Dow Pharmaceuticals, Inc., 874 F.2d 307, 309 (5th Cir.), *modified*, 884 F.2d 166 (1989), *cert. denied*, 494 U.S. 1046, 110 S.Ct. 1511, 108 L.Ed.2d 646 (1990). Because expert evidence can be hard to evaluate, it can be both powerful and misleading. Weinstein, *Rule 702 of the Federal Rules of Evidence is Sound; It Should Not Be Amended*, 138 F.R.D. 631, 632 (1991). Consequently, some commentators believe that "ostensibly scientific testimony may sway a jury even when as science it is palpably wrong." Black, *supra*, at 789.

In light of the increased use of expert witnesses and the likely prejudicial impact of their testimony, trial judges have a heightened responsibility to ensure that expert testimony show some indicia of reliability. See In re Air Crash Disaster, 795 F.2d at 1234 (stating that "experts whose opinions are available to the highest bidder have no place testifying in a court of law, before a jury, and with the imprimatur of the trial judge's decision *554 that he is an `expert'"). It is especially important that trial judges scrutinize proffered evidence for scientific reliability when it is based upon novel scientific theories, sometimes referred to as "junk science."

Concerns over the abusive use of the professional expert witness have led some commentators to call for the adoption of a reliability standard for Rule 702 of the Texas Rules of Civil Evidence. See, e.g., 2 Goode, *supra*, § 702.5, at 37-38 (urging the adoption of a reliability standard and noting that the "goal of rooting out bogus expert opinion from the Texas courts is laudable"); Sutton, *Article VII: Opinions and Expert Testimony in Texas Rules of Evidence Handbook*, 30 Hous.L.Rev. 797, 842 (2d ed. 1993) (stating that reliability, rather than general acceptance, is the appropriate standard for dealing with the problems related to expert testimony); cf. Pope, *The Presentation of Scientific Evidence*, 31 TEX.L.REV. 794, 794 (1953) (arguing that evidence which departs from the scientific method should not be admitted).

B.

Rule 702 of the Texas Rules of Civil Evidence, which governs the admission of expert testimony, provides as follows:

If scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion or otherwise.

Since the adoption of Rule 702 in 1983, this Court has not had occasion to address the proper standard for the admission of expert testimony. (We have addressed the legal sufficiency of scientific evidence, an inquiry which is outside the scope of Rule 702. See, e.g., Duff v. Yelin, 751 S.W.2d 175, 176 (Tex. 1988).) The courts of appeals, however, have been presented with this issue and have come to differing conclusions. Some courts of appeals have limited the trial court's inquiry to assessing the expert's qualifications. E.g., Guentzel, 768 S.W.2d at 897; Vogelsang v. Reece Import Autos, Inc., 745 S.W.2d 47, 49 (Tex.App.—Dallas 1987, no writ) (holding that the trial court only makes the "threshold finding, that the

witness possesses minimal qualifications as an expert"). Other courts have held that the proper inquiry for the admission of expert evidence is whether the underlying scientific principle is sufficiently reliable to be of assistance to the trier of fact. *E.g.*, *Gannett Outdoor Co. of Tex. v. Kubeczka*, 710 S.W.2d 79, 89 (Tex.App.—Houston [14th Dist.] 1986, no writ); *Thompson v. Mayes*, 707 S.W.2d 951, 956 (Tex.App.—Eastland 1986, writ ref'd n.r.e.).

We granted DuPont's application for writ of error to resolve the conflict between the courts of appeals by determining the appropriate standard for the admission of scientific expert testimony. DuPont argues that under "the court of appeals' restricted guidelines, the trial judge is not a gatekeeper but an idle spectator rendered powerless to ensure the integrity of courtroom evidence." In order to stem the flow of the use of "junk science" and "kitchen chemistry" in our courts, DuPont urges us to adopt a reliability standard similar to the standards applicable to Rules 702 of the Federal Rules of Evidence and the Texas Rules of Criminal Evidence, which are identical to Rule 702 of the Texas Rules of Civil Evidence.

C.

In *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579, 589-90, 113 S.Ct. 2786, 2795, 125 L.Ed.2d 469 (1993), the United States Supreme Court stated that Rule 702 of the Federal Rules of Evidence requires scientific expert testimony to be reliable and relevant. The underlying suit arose when two minor children were born with birth defects. Their parents sued Merrell Dow, alleging that the mothers' ingestion during their pregnancies of Bendectin, an anti-nausea drug manufactured and marketed by Merrell Dow, caused the birth defects. Although there were more than thirty published studies which concluded that Bendectin was not capable of causing birth defects in unborn babies, the plaintiffs submitted the testimony of eight experts who claimed that Bendectin was a cause of birth defects. The plaintiffs' experts based their opinions on animal studies, pharmacological studies, and a reanalysis of previously published epidemiological studies. The district court granted Merrell Dow's motion for summary judgment because the plaintiffs failed to establish that the principle upon which their experts based their opinions was generally accepted by the relevant scientific community. *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 727 F.Supp. 570, 572 (S.D.Cal.1989) (quoting *United States v. Kilgus*, 571 F.2d 508, 510 (9th Cir.1978)). The Ninth Circuit Court of Appeals affirmed, citing *Frye v. United States*, 293 F. 1013, 1014 (D.C.Cir.1923), which established the "general acceptance" test.^[1] *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 951 F.2d 1128, 1131 (9th Cir.1991), *vacated*, 509 U.S. 579, 113 S.Ct. 2786, 125 L.Ed.2d 469 (1993).

The Supreme Court held that Rule 702 did not incorporate the *Frye* test, noting that *Frye's* restrictive "general acceptance" test was at odds with the liberal approach of the Federal Rules of Evidence. *Daubert*, 509 U.S. at 588, 113 S.Ct. at 2794 (quoting *Beech Aircraft Corp. v. Rainey*, 488 U.S. 153, 169, 109 S.Ct. 439, 450, 102 L.Ed.2d 445 (1988)). Rather, Rule 702 requires the proffered testimony to be: (1) "scientific knowledge" (2) which will "assist the trier of fact to understand the evidence or to determine a fact in issue." *Id.* at 589, 113 S.Ct. at 2795 (quoting Fed.R.Evid. 702). To constitute "scientific knowledge," the proffered testimony must be reliable. *Id.* In addition, to be helpful to the trier of fact, the evidence must be relevant. Scientific evidence is relevant when there is a "valid scientific connection to the pertinent inquiry as a precondition to admissibility." *Id.* at 592, 113 S.Ct. at 2796. The Court enumerated four non-exclusive factors to aid trial judges in determining whether scientific evidence is relevant and reliable and thus admissible under Federal Rule of Evidence 702: (1) whether a theory or technique can be and has been tested (falsifiability); (2) whether the theory or technique has been subjected to peer review and publication; (3) the technique's known or potential rate of error; and (4) the general acceptance of the theory or technique by the relevant scientific community. *Id.* at 591-94, 113 S.Ct. at 2796-97.

The Supreme Court remanded *Daubert* to the Ninth Circuit, directing it to determine whether the expert testimony rested "on a reliable foundation" and was relevant to the issues in the case. *Id.* at 597, 113 S.Ct. at 2799. Upon remand, the Ninth Circuit held the testimony regarding Bendectin's effects was inadmissible under Rule 702, in part because it was not based on a reliable methodology. *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 43 F.3d 1311, 1322 (9th Cir. 1995) (upon remand). The court noted that two factors indicated the expert testimony was not reliable. The first factor was that the experts had conducted their research for the purpose of testifying, rather than independently of any litigation. *Id.* at 1317. The second factor was the lack of any peer review or publication of the research analysis supporting the experts' conclusions. *Id.* at 1318. The court noted that "the only review the plaintiffs' experts' work has received has been by judges

and juries, and the only place their theories and studies have been published is in the pages of federal and state reporters." *Id.* The court further held that the evidence was not helpful to the jury, and thus was not relevant, because the experts could not say that the Bendectin had caused the plaintiffs' injuries or that it had more than doubled the likelihood of birth defects. *Id.* at 1322.

556 Since *Daubert*, one Texas court of appeals has adopted a combined reliability and relevancy standard for determining the admissibility of evidence offered pursuant to Rule 702 of the Texas Rules of Civil Evidence. See *North Dallas Diagnostic Ctr. v. Dewberry*, *556 900 S.W.2d 90, 94 (Tex.App.—Dallas 1995, n.w.h.). Two courts of appeals have come to differing conclusions about whether a *Daubert*-type standard governs appellate reviews of the legal sufficiency of scientific expert testimony. Compare *Merrell Dow Pharmaceuticals, Inc. v. Havner*, 907 S.W.2d 535, 542 (Tex.App.—Corpus Christi 1994, n.w.h.) (holding that "an expert scientific opinion must be grounded, at the very least, on some demonstrable underlying scientific data or logical inferences therefrom") with *Maritime Overseas Corp. v. Ellis*, 886 S.W.2d 780, 787, 791-92 (Tex.App.—Houston [14th Dist.] 1994, writ pending) (rejecting *Daubert*'s "scientific methodology" approach as the controlling standard of evidence in Texas negligence cases and in suits brought under the Jones Act, 46 U.S.C.App. § 688).

The Texas Court of Criminal Appeals also has held that scientific evidence offered pursuant to Rule 702 of the Texas Rules of Criminal Evidence must be relevant and reliable. See *Kelly v. State*, 824 S.W.2d 568 (Tex.Crim.App.1992). In *Kelly*, a defendant convicted of murder appealed the trial court's ruling on the admissibility of the State's DNA "fingerprint" evidence. At trial, the defendant objected to the admission of the State's expert testimony regarding DNA identification test results, arguing that the tests were not generally accepted as reliable by the scientific community. *Id.* at 569. The trial court admitted the testimony over the defendant's objection. *Id.* at 570. The court of appeals affirmed, based on its finding that DNA evidence was scientifically reliable. *Kelly v. State*, 792 S.W.2d 579, 585 (Tex. App.—Fort Worth 1990.) *aff'd*, 824 S.W.2d 568 (Tex.Crim.App.1992). The Court of Criminal Appeals approved, holding that evidence is reliable if the underlying theory and the technique applying it are valid, and if the technique was properly applied on the occasion in question. *Kelly*, 824 S.W.2d at 573. Under *Kelly*, factors affecting the trial court's determination of reliability include: (1) general acceptance of the theory and technique by the relevant scientific community; (2) the expert's qualifications; (3) the existence of literature supporting or rejecting the theory; (4) the technique's potential rate of error; (5) the availability of other experts to test and evaluate the technique; (6) the clarity with which the theory or technique can be explained to the trial court; and (7) the experience and skill of the person who applied the technique on the occasion in question. *Id.* (citing 3 Weinstein & Berger, WEINSTEIN'S EVIDENCE ¶ 702[03] (1991)).

D.

We are persuaded by the reasoning in *Daubert* and *Kelly*. Therefore, we hold that in addition to showing that an expert witness is qualified, Rule 702 also requires the proponent to show that the expert's testimony is relevant to the issues in the case and is based upon a reliable foundation. The trial court is responsible for making the preliminary determination of whether the proffered testimony meets the standards set forth today. See TEX.R.CIV.EVID. 104(a) (stating that the trial court is to decide preliminary questions concerning the admissibility of evidence).

Rule 702 contains three requirements for the admission of expert testimony: (1) the witness must be qualified; (2) the proposed testimony must be "scientific ... knowledge"; and (3) the testimony must "assist the trier of fact to understand the evidence or to determine a fact in issue." TEX.R.CIV.EVID. 702. In order to constitute scientific knowledge which will assist the trier of fact, the proposed testimony must be relevant and reliable.

The requirement that the proposed testimony be relevant incorporates traditional relevancy analysis under Rules 401 and 402 of the Texas Rules of Civil Evidence. To be relevant, the proposed testimony must be "sufficiently tied to the facts of the case that it will aid the jury in resolving a factual dispute." *United States v. Downing*, 753 F.2d 1224, 1242 (3d Cir.1985); see *Daubert*, 509 U.S. at 589-93, 113 S.Ct. at 2795-96. Evidence that has no relationship to any of the issues in the case is irrelevant and does not satisfy Rule 702's requirement that the testimony be of assistance to the jury. 3 WEINSTEIN & BERGER, WEINSTEIN'S EVIDENCE, ¶ 702[02] (1994). It is thus inadmissible under Rule 702 as well as

under Rules 401 and 402.

557 *557 In addition to being relevant, the underlying scientific technique or principle must be reliable. Scientific evidence which is not grounded "in the methods and procedures of science" is no more than "subjective belief or unsupported speculation." Daubert, 509 U.S. at 590, 113 S.Ct. at 2795. Unreliable evidence is of no assistance to the trier of fact and is therefore inadmissible under Rule 702. Kelly, 824 S.W.2d at 572 (quoting Kreiling, *Scientific Evidence: Toward Providing the Lay Trier with the Comprehensible and Reliable Evidence Necessary to Meet the Goals of the Rules of Evidence*, 32 ARIZ. L.REV. 915, 941-42 (1990)).

There are many factors that a trial court may consider in making the threshold determination of admissibility under Rule 702. These factors include, but are not limited to:

- (1) the extent to which the theory has been or can be tested;
- (2) the extent to which the technique relies upon the subjective interpretation of the expert, 3 Weinstein & Berger, *supra*, ¶ 702[03];
- (3) whether the theory has been subjected to peer review and/or publication;
- (4) the technique's potential rate of error;
- (5) whether the underlying theory or technique has been generally accepted as valid by the relevant scientific community; and
- (6) the non-judicial uses which have been made of the theory or technique.^[2]

We emphasize that the factors mentioned above are non-exclusive. Trial courts may consider other factors which are helpful to determining the reliability of the scientific evidence. The factors a trial court will find helpful in determining whether the underlying theories and techniques of the proffered evidence are scientifically reliable will differ with each particular case.

If the trial judge determines that the proffered testimony is relevant and reliable, he or she must then determine whether to exclude the evidence because its probative value is outweighed by the "danger of unfair prejudice, confusion of the issues, or misleading the jury, or by considerations of undue delay, or needless presentation of cumulative evidence." TEX.R.CIV.EVID. 403; see Daubert, 509 U.S. at 595-96, 113 S.Ct. at 2798; Kelly, 824 S.W.2d at 572; Dudley v. Humana Hosp. Corp., 817 S.W.2d 124, 127 (Tex. App.—Houston [14th Dist.] 1991, no writ).

We are confident that our trial courts will use great care when determining whether expert testimony is admissible under Rule 702. As the Supreme Court noted in Daubert, Rule 702 envisions a flexible inquiry focusing solely on the underlying principles and methodology, not on the conclusions they generate. 509 U.S. at 593-94, 113 S.Ct. at 2797; see Christophersen v. Allied-Signal Corp., 939 F.2d 1106, 1111 (5th Cir.1991) (en banc) (holding, in a pre-Daubert decision, that if the "expert's methodology is well founded, the nature of the expert's conclusion is generally irrelevant [to a determination of its admissibility], even if it is controversial or unique"), cert. denied, 503 U.S. 912, 112 S.Ct. 1280, 117 L.Ed.2d 506 (1992).

The dissenting opinion argues that the party objecting to the admission of the proffered evidence has the burden to prove that it is not admissible. 923 S.W.2d 549, 567. We disagree. Once the party opposing the evidence objects, the proponent bears the burden of demonstrating its admissibility. DuPont filed a motion to exclude Dr. Whitcomb's testimony, detailing with specificity the bases for its motion. At that point, the Robinsons bore the burden to establish the admissibility of the proffered evidence.

The dissenting opinion also criticizes our approach, arguing that it places a judge in "the role of amateur scientist" and that judges are not competent to assess the scientific reliability of expert testimony. *Id.* at 565. However, a judge does not have to be trained in science to evaluate the reliability of a theory or technique. See Black, *supra* at 753 (stating that, although

558 "the details of science may be complex," "the characteristics of valid scientific knowledge and the kind of *558 reasoning

that produce it are not difficult to grasp"). Judges are capable of understanding and evaluating scientific reliability. See Faigman, *To Have and Have Not: Assessing the Value of Social Science to the Law as Science and Policy*, 38 Emory L.J. 1005, 1014 (1989). In fact, there is some authority that they are better-equipped to do so than are juries. As one commentator recently noted:

Juries must depend mostly on listening to oral testimony, often mixed in with evidence about other issues. Judges, however, have the benefit of reviewing documents and briefs.... Over time, most judges will probably develop at least some facility for understanding science beyond the typical juror's level of understanding. Taking the time required to educate jurors and to present them with similarly detailed information could easily overwhelm the other issues in a case.

Black, *supra*, at 788 (footnotes omitted). Moreover, many lawyers hesitate to extensively cross-examine expert witnesses because it can be difficult to explain weaknesses in the testimony to the jury and can even make things worse. See *id.* at 789. On the other hand, judges can freely ask questions in a preliminary hearing and thus can glean more information without these risks. *Id.* at 790.

E.

The Robinsons contend that allowing the trial judge to assess the reliability of expert testimony violates their federal and state constitutional rights to a jury trial by infringing upon the jury's inherent authority to assess the credibility of witnesses and the weight to be given their testimony. See U.S. CONST. amend. VII; TEX. CONST. art. 5, § 10. We disagree. The right to a jury trial "was designed to preserve the basic institution of jury trial in only its most fundamental elements, not the great mass of procedural forms and details." *Parklane Hosiery Co. v. Shore*, 439 U.S. 322, 337, 99 S.Ct. 645, 654, 58 L.Ed.2d 552 (1979) (quoting *Galloway v. United States*, 319 U.S. 372, 392, 63 S.Ct. 1077, 1088, 87 L.Ed. 1458 (1943)). Moreover, under the standards enunciated today, the jury will continue to assess the weight and credibility of the proffered testimony.

The trial court's role is not to determine the truth or falsity of the expert's opinion. See *In re Paoli R.R. Yard PCB Litig.*, 35 F.3d 717, 749 (3d Cir.1994), cert. denied sub nom. *General Elec. Co. v. Ingram*, U.S. , 115 S.Ct. 1253, 131 L.Ed.2d 134 (1995). Rather, the trial court's role is to make the initial determination whether the expert's opinion is relevant and whether the methods and research upon which it is based are reliable. There is a difference between the reliability of the underlying theory or technique and the credibility of the witness who proposes to testify about it. An expert witness may be very believable, but his or her conclusions may be based upon unreliable methodology. As DuPont points out, a person with a degree should not be allowed to testify that the world is flat, that the moon is made of green cheese, or that the Earth is the center of the solar system.

III.

We now determine whether the trial court abused its discretion in excluding Dr. Whitcomb's testimony. The test for abuse of discretion is whether the trial court acted without reference to any guiding rules or principles. *Downer v. Aquamarine Operators, Inc.*, 701 S.W.2d 238, 241-42 (Tex. 1985), cert. denied, 476 U.S. 1159, 106 S.Ct. 2279, 90 L.Ed.2d 721 (1986). The test is not whether, "in the opinion of the reviewing court, the facts present an appropriate case for the trial court's action." *Id.* A reviewing court cannot conclude that a trial court abused its discretion if, in the same circumstances, it would have ruled differently or if the trial court committed a mere error in judgment. *Loftin v. Martin*, 776 S.W.2d 145, 146 (Tex.1989); *Downer*, 701 S.W.2d at 242; *Jones v. Strayhorn*, 159 Tex. 421, 321 S.W.2d 290, 295 (1959). The decision whether to admit evidence rests within the discretion of the trial court. *Ginsberg v. Fifth Court of Appeals*, 686 S.W.2d 105, 108 (Tex.1985).

559 Applying these principles, we cannot conclude that the trial court abused its discretion by excluding Dr. Whitcomb's testimony. It was not based upon a reliable foundation. Dr. Whitcomb conducted no testing to *559 exclude other possible causes of the damage to the Robinsons' pecan orchard, even though he admitted in his deposition that many of the

symptoms could be caused by something other than contaminated Benlate. For instance, Dr. Whitcomb stated in his deposition that any number of things, including root rot, could have caused chlorosis, a yellowing of the leaves, on the Robinsons' trees. An expert who is trying to find a cause of something should carefully consider alternative causes. In re Paoli, 35 F.3d at 758-59. Dr. Whitcomb's failure to rule out other causes of the damage renders his opinion little more than speculation.

Dr. Whitcomb's testimony is also problematic because of his methodology. Scientists may form initial tentative hypotheses. However, "coming to a firm conclusion first and then doing research to support it is the antithesis of this [scientific] method." Claar v. Burlington Northern R.R., 29 F.3d 499, 502-03 (9th Cir.1994). Dr. Whitcomb's methodology is similar to that condemned by the court in Sorensen v. Shaklee Corp., 31 F.3d 638 (8th Cir.1994):

Here the hypotheses presented by the plaintiffs' experts follow no scientific principles. Those opinions reason that, because [the children] sustained birth defects (mental retardation) and their parents used Shaklee's alfalfa tablets, and because some alfalfa tablets had contained an EtO residue, the parents must have ingested the EtO residue tablets. That inference turns scientific analysis on its head. *Instead of reasoning from known facts to reach a conclusion, the experts here reasoned from an end result in order to hypothesize what needed to be known but what was not.*

While it may be that this sort of reasoning could pass muster in some cases where the obvious result explains the etiology (for example, where a fractured bone accompanied by bruised outer skin and flesh demonstrate that some type of physical contact caused the injury) *such reasoning cannot apply here where several possible causes could have produced one effect.*

Id. at 649 (emphases added). In this case, Dr. Whitcomb had no proof that the Robinsons' Benlate was contaminated with SU herbicides, and no knowledge as to what amount or concentration of SU herbicides would damage pecan trees. Nonetheless, he determined, without any testing to exclude other causes, that because the Robinsons applied Benlate to their trees, and the trees showed signs of damage, the Benlate must have been contaminated.

Another factor weighing against the admissibility of Dr. Whitcomb's testimony is that his research and opinions were conducted and formed for the purpose of litigation. The fact that an opinion was formed solely for the purposes of litigation does not automatically render it unreliable. However, "when an expert prepares reports and findings before being hired as a witness, that record will limit the degree to which he can tailor his testimony to serve a party's interests." Daubert, 43 F.3d at 1317 (upon remand). On the other hand, opinions formed solely for the purpose of testifying are more likely to be biased toward a particular result. *Id.*

Finally, the Robinsons have offered no evidence to support their claim that comparative symptomology is an appropriate and reliable method to determine chemical contamination. Dr. Whitcomb's method of comparative symptomology has not been subjected to peer review or publication. Dr. Warde found that there was a ninety-nine percent probability that Dr. Whitcomb's *conclusion* that Benlate damaged the plants in Dr. Whitcomb's study was correct. However, the approach we adopt today inquires whether the particular *technique or methodology* has been subjected to a rate of error analysis. Moreover, there is no evidence that comparative symptomology has been generally accepted by members of the *relevant* scientific community. Dr. Whitcomb's self-serving statements that his methodology was generally accepted and reasonably relied upon by other experts in the field are not sufficient to establish the reliability of the technique and theory underlying his opinion. Daubert, 43 F.3d at 1316 (upon remand) (stating that an "expert's bald assurance of validity is not enough").

560 Also not sufficient to show general acceptance of Dr. Whitcomb's theory or *560 technique is the fact that other organizations were *studying* the effects of Benlate on plant life.

IV.

Because Dr. Whitcomb's testimony and opinions were not reliable, we hold that the trial court did not abuse its discretion by excluding Dr. Whitcomb's testimony. Accordingly, we reverse the judgment of the court of appeals and affirm the judgment of the trial court.

CORNYN, Justice, joined by HIGHTOWER, GAMMAGE and SPECTOR, Justices, dissenting.

Whether jurors will be permitted to hear testimony on an essential element of the plaintiffs' lawsuit, and accept or reject it, in whole or in part as they see fit, is the issue with which we are presented. It is not whether we as judges find such evidence credible or "reliable," to use the terminology adopted by the Court. Determining credibility is uniquely a jury function. Although I share the Court's concern about admission of unsupported expert testimony, see Havner v. E-Z Mart Stores, Inc., 825 S.W.2d 456, 464-66 (Tex.1992) (Cornyn, J., dissenting), I do not think that the Court correctly applies the Texas Rules of Evidence to the facts of this case. Nor does the Court establish a workable or wise rule for regulating the admission of such evidence.

The rule adopted by the Court is unworkable because it requires judges to venture upon a determination that the foundation for an expert witness's opinion is "scientifically reliable." In so holding, the Court reflexively embraces what the Supreme Court itself referred to as only "general observations" in Daubert v. Merrell Dow Pharmaceuticals, Inc., 509 U.S. 579, 591-93, 113 S.Ct. 2786, 2796, 125 L.Ed.2d 469 (1993). The Court also overlooks the fact that these general observations were directed at only a narrow subspecies of expert testimony, novel scientific evidence, and thus are of doubtful application in this case. Finally, the *Daubert* dicta thrusts judges, by and large untrained in science, into the inappropriate role of amateur scientists, see *id.* at 599, 113 S.Ct. at 2800 (Rehnquist, C.J., concurring and dissenting), and has been rejected as either inapplicable or unworkable by numerous state and federal courts.^[1]

The Court's requirement that trial judges determine the reliability of scientific testimony is unwise because it threatens to invade the jury's province as "the sole judge of the credibility of the witnesses and the weight to be given their testimony." See TEX.R.CIV.P. 226a (approved instructions) pt. III.

Aside from these disagreements over the proper standard to be applied to novel scientific testimony, I believe the majority today errs in a more fundamental way: In the Court's haste to uncritically embrace *Daubert*, it overlooks two alternative reasons for admitting the expert testimony at issue in this case. First, the Court overlooks the fact that Dr. Whitcomb's testimony was based on both: (1) facts and data normally relied upon by experts in the field of horticulture; and (2) first-hand knowledge gained by personal observations and investigation of the potential causes of the damage to the Robinsons' pecan trees. This second source of information is independently sufficient under Rule 703 of the Texas Rules of Civil Evidence to require admission of Dr. Whitcomb's testimony, regardless of the Court's evaluation of *561 the separate scientific study he performed. Indeed, DuPont does not even contest this basis for the admission of Whitcomb's testimony.

Second, the Court overlooks the lack of any evidence to controvert Dr. Whitcomb's testimony that his opinions are grounded in good science. Although DuPont's attorneys vigorously argued that Whitcomb's testimony was not admissible under the *Daubert* standard. DuPont offered no rebuttal testimony in the trial court with which the court might assess the validity of Dr. Whitcomb's methods. No evidence, just unsupported arguments of counsel, has been offered to show that the facts and data relied upon by Dr. Whitcomb are not of the type routinely relied upon by experts in the field. Accordingly, I dissent.

I.

There are certain threshold requirements that all expert testimony must meet to be admissible. Our rules of evidence provide that "[a]ll relevant evidence is admissible, except as otherwise provided by Constitution, by statute, by these rules, or by other rules prescribed by the Supreme Court pursuant to statutory authority." TEX.R.CIV.EVID. 402.^[2] Undeniably, Dr. Whitcomb's testimony about what caused the damage to the Robinsons' pecan trees satisfies this relevance requirement.

Furthermore, expert testimony must be given by "a witness qualified as an expert by knowledge, skill, experience, training, or education." TEX.R.CIV.EVID. 702. No one asserts that Dr. Whitcomb is unqualified as an expert witness under Rule 702. To the contrary, all agree that he is qualified by virtue of his education and experience to testify as an expert witness, and no one contests that the subject matter of his testimony is appropriately provided by expert opinion.

Finally, his testimony is rather clearly designed to "assist the trier of fact to understand the evidence or to determine a fact in issue." TEX.R.CIV.EVID. 702.^[3] This requirement is consistent with our observation that

[e]xpert testimony concerning the possible causes of the condition in question will often assist the trier of fact in evaluating other evidence in the case. If the witness were permitted to state his opinion only in terms of ... probabilities, moreover, the court and jury would have no opportunity to decide the case on the basis of the substance rather than the form of his testimony.

Lenger v. Physician's Gen. Hosp., 455 S.W.2d 703, 707 (Tex.1970).

II.

Once these general requirements are met, Rule 703 presents a more specific substantive hurdle for the admission of expert testimony.^[4] Rule 703 addresses the types of "facts *562 or data" upon which the expert's opinion can be based:

The facts or data in the particular case upon which an expert bases an opinion or inference may be those perceived by or reviewed by the expert at or before the hearing. If of a type reasonably relied upon by experts in the particular field in forming opinions or inferences upon the subject, the facts or data need not be admissible in evidence.

TEX.R.CIV.EVID. 703. Broken down into its components, the rule contemplates three sources of the "facts or data" that might underlie the expert's testimony: (1) first-hand knowledge; (2) hypothetical questions based on admitted evidence,^[5] and (3) inadmissible data, if of a type reasonably relied upon by experts in the particular field in forming opinions or inferences upon the subject. See Fed.R.Evid. 703 Advisory Committee's Note; Sutton, *Commentary on Expert Testimony*, in TEXAS RULES OF EVIDENCE HANDBOOK 847 (2d ed. 1993).

Placed within the framework of Rule 703, Dr. Whitcomb's testimony of a cause-and-effect relationship between the Benlate and the damage to the Robinsons' trees rested on two permissible bases: (1) first-hand observation, that is, facts perceived by the witness himself; and (2) information of a type that, although inadmissible in the present case, would be, in the words of the rule, "reasonably relied upon by experts in the particular field in forming opinions or inferences on the subject." See TEX.R.CIV.EVID. 703. This is demonstrated in the following sections.

A.

Dr. Whitcomb's excluded testimony was based, at least in part, on the following first-hand observations made during his inspection of the Robinsons' orchard in 1992: (1) many leaves had an unusual coloration or were deformed in shape, but the pattern of occurrences were inconsistent with frost damage, insect infestation, or nutrient deficiencies; (2) many nuts had failed to form properly, but the deformities were not consistent with nutrient deficiencies or drought; (3) roots had failed to develop normally, but the abnormalities were inconsistent with freeze damage, drought, or root rot; (4) new growth in the limbs of the trees had failed to develop normally or had experienced die-back; (5) soil conditions were of adequate depth and consistency to support a pecan orchard; (6) drainage patterns in the orchard were sufficient to prevent excess accumulations of rainfall that could damage pecan trees; and (7) insects were not present in any appreciable level.

This first category of "facts or data" is not contested by DuPont, nor is it even discussed by the Court. In fact, many of the exhibits tendered by DuPont in support of its motion to exclude Dr. Whitcomb's testimony relied upon similar first-hand observations. Alone, this type of information is a sufficient basis for rendition of an expert opinion, for whatever weight (if any) the factfinder might give it. See WEINSTEIN ET AL., WEINSTEIN'S EVIDENCE § 703-7 (1995) ("Personal observation has always been an adequate basis for an expert's opinion, and indeed has been called the most desirable of all bases." (quoting FED.R.EVID. 703 Advisory Committee's Note)).

Dr. Whitcomb's testimony based on his personal observations is roughly analogous to that which may be offered by a

physician, who may testify based on nothing more than a personal examination, the patient's history, and correspondence with other physicians. See Hart v. Van Zandt, 399 S.W.2d 791, 798 (Tex.1965); see also GOODE ET AL., GUIDE TO THE TEXAS RULES OF EVIDENCE: CIVIL AND CRIMINAL § 703.3 at 51 (1993). To the extent Dr. Whitcomb was simply applying his extensive knowledge of horticultural phenomena to observable conditions in the Robinsons' orchard, his testimony was unquestionably admissible. On this basis alone, the trial court erred in excluding all of Dr. Whitcomb's testimony.

563 The rationale behind this admittedly expansive standard for the admission of expert opinions based on personal observations may be better understood in the context of change *563 in Texas law wrought by adoption of Rule 703. As late as 1980, Texas law disallowed admission of expert opinions based solely on hearsay evidence, mainly because this basis for the expert's testimony was not considered sufficiently trustworthy. See Moore v. Grantham, 599 S.W.2d 287, 289 (Tex.1980). The Court's adoption of the Rules, however, overruled *Moore* and allowed an expert to base opinion testimony entirely on inadmissible evidence, but the concern for the trustworthiness of the underlying basis for the expert's opinion did not evaporate. Instead, Rule 703 requires that if an expert intends to base an opinion solely on hearsay evidence, that it must be of a type reasonably relied upon by experts in the particular field in forming opinions or inferences upon the subject. See WENDORF ET AL., TEXAS RULES OF EVIDENCE MANUAL at VII-15; Fed.R.Evid. 703 Advisory Committee's Note. This change was designed to broaden the basis for expert opinions and to bring courtroom practice in line with the practice of experts themselves when they are not in court. *Id.*

There is, however, no similar limitation on expert opinions based on *admitted* evidence. See GOODE ET AL., *supra*, § 703.3 at 51. If an expert bases an opinion on admitted evidence, that is, evidence already before the jury, "sufficient guarantees of trustworthiness are ordinarily present to assure the reasonableness of the expert's reliance in the particular case." See *id.* The weight, if any, to be given to that testimony is then solely within the province of the jury. See People v. Wesley, 83 N.Y.2d 417, 611 N.Y.S.2d 97, 104, 633 N.E.2d 451, 458 (1994) (stating that the court cannot determine whether the evidence underlying an expert's opinion is true because that determination is a jury function). As Dean Sutton points out: "The jury can evaluate this evidence only indirectly by judging the credibility of the expert." Sutton, *supra*, at 853. Thus, the Rules confer no authority on a court to exclude expert testimony that is based solely on evidence already before the jury, provided it meets the threshold requirements discussed above.

B.

Dr. Whitcomb's excluded testimony was also based on the following facts or data that are of the type reasonably relied upon by experts in his field: (1) a comparison between the damage to the Robinsons' orchard and damage occurring in other pecan trees treated with Benlate; (2) a comparison between the damage to the Robinsons' orchard and damage to other plants treated with Benlate under a controlled scientific study conducted in 1992 (the "Comparative Symptomology Study");^[6] (3) a comparison between the damage to the Robinsons' orchard and damage reported in over five-hundred pages worth of articles about herbicides in peer-reviewed journals and in other authoritative reports; (4) a review of various DuPont memoranda reporting allegations of plant damage following application of Benlate; (5) a review of various DuPont 564 memoranda discussing the potential contamination *564 of some of its products such as Benlate; and (6) a chemical analysis of ten boxes of Benlate that revealed 18 identifiable foreign compounds (contaminants, according to Dr. Whitcomb) between the ten boxes, with only five common to all boxes. Furthermore, the statistical conclusions of Dr. Whitcomb's Comparative Symptomology Study were reviewed by Dr. William Warde, a Professor of Statistics at Oklahoma State University; and his findings were also reviewed by Dr. George Madden, a Ph.D horticulturist who previously worked for the United States Government at the Brownwood Pecan USA Research Pecan Orchard.

Based on the forgoing information, Dr. Whitcomb concluded that contaminated Benlate was, in all scientific probability, the cause of damage to the Robinsons' pecan trees. He conceded that he could not prove the mechanism by which various contaminants caused the damage because the level of contamination was below the level of detection by state of the art techniques, as low as 20 parts per trillion. Nonetheless, he was of the opinion that toxic contaminants were present and that these contaminants caused the damage observed.

DuPont's objections were focused on the reliability of the opinions supported by these bases.^[7] DuPont argues that it is "dubious methodology [that] is the source of the trial courts exercise of discretion in excluding Dr. Whitcomb's `opinions.'" In response, the Robinsons argue that Dr. Whitcomb used scientific procedures^[8] reasonably relied upon by experts in his field.

Applying Rule 703 to the bases underlying Dr. Whitcomb's testimony, I think it is clear that his testimony should have been admitted. Dr. Whitcomb performed controlled testing and chemical analysis. Both types of tests are well-established in the field of science. Dr. Whitcomb reviewed the literature that he deemed authoritative on Benlate and on potential contaminants. Reliance on literature published by a scientist's peers is central to the scientific process. In short, the facts and data relied upon are the type reasonably relied upon by experts in the field. In my view, that should end the inquiry.

The bases of Dr. Whitcomb's testimony are clearly distinguishable from the scientific methods usually at issue in the type of "novel scientific testimony" cases with which *Daubert* was concerned. His testimony did not purport to rely upon new methods of detecting the fact at issue, as was historically the concern with cases involving polygraph tests, voice spectrogram analysis, and DNA evidence. He did not purport to be able to discern new insights from existing studies that other scientists had missed, as was the case in *Daubert* when the experts "re-analyzed" the data in existing Bendectin studies and reached opposite conclusions from the authors of the studies. Instead, Dr. Whitcomb employed traditional scientific methods: observation, comparison, experimentation with control groups, and deductive reasoning to form his opinions. If the Court had focused on these methods of incorporating facts and data into an expert opinion, it would have concluded that Dr. Whitcomb used methods that are reasonably relied upon by experts in the field.

The Court today avoids such a straight-forward analysis of the bases for Dr. Whitcomb's opinions, and in its place adopts a standard of "reliability." 923 S.W.2d 549. This reliability standard shifts the focus of the admissibility inquiry. Under the plain language of Rule 703, the focus is on the normal practices of the relevant community of scientists: Do reasonable
565 experts in the field employ the same methods and data? *565 Under the reliability standard, the focus is on the independent validity of the methods, data, and conclusions themselves: Are the types of facts and data upon which the opinion is based sufficiently reliable to support the conclusion drawn?

Under the interpretation that the Court adopts today, the trial judge is left with no benchmark against which to measure the reliability of the proffered testimony. The judge must assume the role of amateur scientist and independently evaluate the reliability of the methods employed by the expert. For instance, if the expert has relied upon an experiment to form his opinion, the judge must evaluate the reliability of that experiment and the applicability of its findings to the facts of the case. This inquiry would require, among other things: (1) an evaluation of whether the confidence level achieved in the experiment was sufficient to assist the trier of fact; (2) an evaluation of whether the experiment eliminated all potential confounding factors; (3) an evaluation of whether other types of experiments could have been performed and whether these alternatives would have provided more reliable information; and (4) an evaluation of whether the experiment's results can be legitimately extrapolated to the facts at hand. The scientists who work in the field may have devoted their professional lives to making these determinations, but the judge must now step into their shoes and independently decide these issues.^[9]

I believe that judges should refrain from determining the admissibility of evidence based on such dubious forays into scientific inquiry. For that reason, I cannot agree with the majority's adoption of *Daubert's* reliability standard.^[10]

III.

Even if we assume that an *independent* evaluation of Dr. Whitcomb's testimony would prove that the testimony is unreliable and not grounded in good science, the trial court erred in making this determination without any evidence in the record to support this conclusion. The majority today fails to consider this complete lack of controverting evidence in the record.

Of course, trial judges have traditionally performed a preliminary fact-finding determination of the admissibility of witness

testimony. See Strong, McCormick on Evidence, § 53 at 212-13 (4th ed. 1992); see also TEX.CIV.R.EVID. 104(a) ("Preliminary questions concerning the qualification of a person to be a witness, the existence of a privilege, or the admissibility of evidence shall be determined by the court..."). Even advocates of a heightened threshold for the admission of expert testimony have noted *566 that "*Daubert* skews the normal judicial process by requiring judges to perform the fact-finding function previously assigned to the jury." See Hamlin, "*Junk Science*" in the Courts: Problems and Solutions, Legal Backgrounder (Washington Legal Found., Vol. 10, No. 20, May 19, 1995). But even if we accept the propriety of this enhanced fact-finding role for the judge, we cannot allow judges to make findings of fact that have no support in the record.

The requirement that findings of fact have support in the record is especially relevant when the court is determining the validity of scientific evidence because, by definition, such evidence is beyond the competency of non-scientists. The Rules assume that scientific evidence in the form of opinions is helpful to the jury in resolving fact questions that require learning or reasoning that is beyond the competency of a lay jury. In such situations, the rules liberally admit opinions based on facts or data reasonably relied upon by experts in the field. Compare TEX.R.CIV. EVID. 701 (limiting lay opinions to those based on the perception of the witness) with TEX.R.CIV.EVID. 703 (allowing expert testimony based on evidence perceived or reviewed by the expert, including inadmissible evidence of the type reasonably relied upon by experts in the field). But by assuming that the subject matter of the opinions is beyond the competency of non-scientist jurors, the Rules necessarily assume that the subject matter of the opinions is also beyond the competency of non-scientist judges. Thus, it would be inconsistent with this assumption to maintain that judges are competent to independently assess the scientific validity of scientific opinion testimony. See Kelly v. State, 824 S.W.2d 568, 576 (Tex.Crim.App.1992) (Clinton, J., concurring) ("The greatest advantage of the *Frye* test is that it essentially leaves the question of validity of novel theories and techniques to those whose vocation it is to view the world from the perspective of the scientific method, viz: the scientists. Trial judges are ill equipped to make the determination whether a given theory or technique has been sufficiently 'tested in the crucible of controlled experimentation and study' that it can accurately be said to gauge the probability of the existence, *vel non*, of the fact in issue."); People v. Leahy, 8 Cal.4th 587, 34 Cal.Rptr.2d 663, 673, 882 P.2d 321, 331 (1994) (rejecting *Daubert* and questioning the competency of the trial court to determine scientific validity); Posner, *The Problems of Jurisprudence* 62 (1990) ("Lawyers and judges (not to mention jurors) are not trained in the scientific method.").

Because judges must logically rely on the information available from experts in the particular field to evaluate the admissibility of expert testimony, the party opposing a given expert witness's testimony must controvert the expert's claim of reasonable reliance.^[11] See Indian Coffee Corp. v. Procter & Gamble Co., 752 F.2d 891, 898 (3d Cir.), cert. denied sub nom. Folger Coffee Co. v. Indian Coffee Corp., 474 U.S. 863, 106 S.Ct. 180, 88 L.Ed.2d 150 (1985) (holding that the trial court erred in excluding experts' testimony when no evidence appeared in the record casting doubt on their testimony that experts *567 in their field rely on the type of information they relied upon); see also Moore v. Polish Power, Inc., 720 S.W.2d 183, 192 (Tex.App.— Dallas 1986, writ ref'd n.r.e.) (holding that the trial court erred in excluding expert testimony after reviewing the record as a whole to determine the reasonableness of the expert's reliance on specific data). But cf. Soden v. Freightliner Corp., 714 F.2d 498, 505 (5th Cir.1983) ("Though courts have afforded experts a wide latitude in picking and choosing the sources on which to base opinions, Rule 703 nonetheless requires courts to examine the reliability of those sources."). Learned treatises represent one basis for the court's determination of reasonable reliance, as would judicial notice under appropriate circumstances. Cf. TEX.R.CIV.EVID. 803(18) (stating that a learned treatise may be "established as a reliable authority by the testimony or admission of the witness or by other expert testimony or by judicial notice"); see also GOODE ET AL., *supra*, § 703.3 at 48. But in the absence of such learned treatises or judicially noticeable facts, if the party opposing such testimony fails to provide the court with evidence controverting the fact that the scientific evidence underlying expert testimony is of a type reasonably relied upon by experts in the field, the trial court would necessarily be required to admit such testimony. If controverting testimony is presented, the trial judge must decide this issue as a preliminary matter under Rule 104(a) of the Texas Rules of Civil Evidence.

The Court, under the aegis of an abuse-of-discretion standard, is apparently willing to allow a trial judge to determine the reliability of scientific testimony without any support in the record. See 923 S.W.2d at 557 (holding that the opponent of expert testimony needs only to object to the testimony, not to produce controverting evidence). The Court's approach is

inconsistent with Texas law. When the trial judge determines a question of fact under Rule 104(a), there must be evidence in the record to support the judge's finding. The trial judge commits an abuse of discretion if a finding of fact is made "without sufficient information upon which a rational decision may be made, as reflected in the appellate record." See Hall, *Revisiting Standards of Review in Civil Appeals*, 24 St. MARY'S L.J. 1045, 1050-53 (1993) (quoting *Reyna v. Reyna*, 738 S.W.2d 772, 774 (Tex. App.—Austin 1987, no writ)). Thus, even under the Court's standard, the opponent of the proffered testimony must produce some evidence that the expert's methods or theories are scientifically unreliable before the trial judge can exclude the testimony.

It is important to stress that the trial judge's determination is distinct from an evaluation of the credibility of the proffered testimony. It is also different from a determination that the underlying scientific evidence itself is *scientifically reliable*. Under Rule 104(a), the trial judge does not weigh the credibility of the evidence in proving the fact issue in question. Rather, the judge weighs the credibility of the conflicting testimony as to the reasonableness of the expert's reliance on the given facts or data. This distinction is critical in maintaining the separate roles of the expert witness, the trial judge, and the jury.

In this case, the proffered testimony of Dr. Whitcomb was based upon both personal observations and upon the application of certain scientific studies, including his Comparative Symptomology Study. DuPont offered several reports by other experts in support of its motion to exclude this testimony. While these reports reached different conclusions as to the cause of the damage to the Robinsons' orchard, none of them directly addressed the reasonableness of Dr. Whitcomb's reliance, in part, on his personal observations or his comparative analysis.

In fact, many of the conclusions reached in these reports rely upon the same type of data that was relied upon by Dr. Whitcomb. For instance, Dr. Whitcomb relied upon the fact that pecan trees are not particularly susceptible to freezing temperatures in excluding cold weather as a cause of the damage. In one report offered by DuPont, its expert, Dr. Stein, relied upon the relative cold-weather sensitivity of particular varieties of pecans to conclude that some of the damage could be attributed to freezing weather in 1989. Similarly, Dr. Whitcomb relied upon his knowledge of the normal root depths of pecan trees to conclude that soil *568 conditions were not responsible for the damage. DuPont's experts also relied upon this data to conclude that soil conditions were at least a partial cause.

Thus, from the records available to the trial judge, there was no basis for his conclusion that the facts or data relied upon by Dr. Whitcomb were not of the type reasonably relied upon by experts in his field, despite the fact that DuPont's experts reached different conclusions when examining the very same data.¹²¹

IV.

As I noted earlier, the Court's conclusion today that the testimony of Dr. Whitcomb is inadmissible relies primarily on dicta from *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, in which the Court offered what it called some "general observations" regarding the admission of novel scientific testimony under Rule 702. See 509 U.S. at 591-93, 113 S.Ct. at 2796. The Supreme Court's narrow holding was that the "general acceptance" standard derived from *Frye v. United States*, 293 F. 1013 (D.C.Cir.1923), did not survive the enactment of the Federal Rules of Evidence in 1975. *Id.* at 587-88, 113 S.Ct. at 2794. But the reader can clearly sense the trepidation of the Ninth Circuit on remand in attempting to apply the Supreme Court's vague "observations" to the case before it. The court wrote:

Our responsibility, then, unless we badly misread the Supreme Court's opinion, is to resolve disputes among respected, well-credentialed scientists about matters squarely within their expertise, in areas where there is not scientific consensus as to what is and what is not "good science," and occasionally to reject such expert testimony because it was not "derived by the scientific method." Mindful of our position in the hierarchy of the federal judiciary, we take a deep breath and proceed with this heady task.

Daubert v. Merrell Dow Pharmaceuticals, Inc. 43 F.3d 1311, 1316 (9th Cir.1995).

The Supreme Court's narrow holding, rejecting the *Frye* test as the exclusive test of admissibility, should not affect Texas

jurisprudence because *Frye* was not the law in this state. The Texas Court of Criminal Appeals rejected the *Frye* standard as inconsistent with Rule 702 three years ago. See *Kelly v. State*, 824 S.W.2d 568, 572 (Tex. Crim.App.1992). In civil cases, we have *never* adopted the *Frye* standard. The first citation to *Frye* in a Texas civil case was in *Maritime Overseas Corp. v. Ellis*, 886 S.W.2d 780, 785 (Tex.App.—Houston, [14th Dist.] 1994, writ requested). Before today, the Texas Supreme Court had never even *cited* the *Frye* standard, mainly because that standard has traditionally applied to novel scientific evidence in criminal cases.^[13]

Despite the existence of a relatively well-settled and sound body of law in Texas, the Court today rushes to adopt the federal standard of reliability from *Daubert*. In so doing, the Court affirms a completely unsupported trial court ruling. Accordingly, I dissent.

[1] The *Frye* case concerned the admissibility of the results of a systolic blood pressure deception test, a precursor to the polygraph machine. Courts derived the "general acceptance" test from the following passage in *Frye*:

Just when a scientific principle or discovery crosses the line between the experimental and demonstrable stages is difficult to define. Somewhere in this twilight zone the evidential force of the principle must be recognized, and while courts will go a long way in admitting expert testimony deduced from a well-recognized scientific principle or discovery, the thing from which the deduction is made must be sufficiently established to have gained *general acceptance* in the particular field in which it belongs.

293 F. at 1014 (emphasis added).

[2] "That an expert testifies based on research he has conducted independent of the litigation provides important, objective proof that the research comports with the dictates of good science." *Daubert*, 43 F.3d at 1317 (upon remand) (citing Huber, *Galileo's Revenge* 206-09 (1991)).

[1] A number of courts have either declined to follow *Daubert* or found it inapplicable: *Vadala v. Teledyne Indus., Inc.*, 44 F.3d 36, 39 (1st Cir. 1995) (holding that *Daubert* is limited to cases involving "scientific law" and not accidents); *Iacobelli Constr. Inc. v. County of Monroe*, 32 F.3d 19, 25 (2d Cir.1994) (concluding that *Daubert* addressed only "junk science" cases and is inapplicable to construction litigation); *Lappe v. American Honda Motor Co.*, 857 F.Supp. 222, 228 (N.D.N.Y.1994) (admitting expert testimony in products liability action because "*Daubert* only prescribes judicial intervention for expert testimony approaching the outer boundaries of traditional scientific and technological knowledge"); *State v. Bible*, 175 Ariz. 549, 580, 858 P.2d 1152, 1183 (1993); *People v. Leahy*, 8 Cal.4th 587, 34 Cal.Rptr.2d 663, 673, 882 P.2d 321, 331 (1994); *Fishback v. People*, 851 P.2d 884, 889 (Colo. 1993); *Flanagan v. State*, 625 So.2d 827, 828-29 (Fla.1993); *State v. Alt*, 504 N.W.2d 38, 45-46 (Minn.Ct.App.1993); *State v. Carter*, 246 Neb. 953, 524 N.W.2d 763, 779 (1994); *People v. Wesley*, 83 N.Y.2d 417, 611 N.Y.S.2d 97, 102, 633 N.E.2d 451, 456 (1994); *State v. Cauthron*, 120 Wash.2d 879, 846 P.2d 502, 505 (1993).

[2] A court could nonetheless exclude relevant, admissible expert testimony on the basis of the balancing test prescribed by Rule 403, which authorizes exclusion of otherwise admissible evidence if its probative value is outweighed by considerations of unfair prejudice, confusion, tendency to mislead, undue delay, or cumulative nature. But here, the trial court did not base its exclusion of this testimony on Rule 403.

[3] Adoption of the Rules of Evidence subtly but significantly modified the former common law requirement that "need" for the expert's testimony be demonstrated, in the sense that the subject matter of the testimony had to be beyond the understanding of a lay jury. WENDORF ET AL., TEXAS RULES OF EVIDENCE MANUAL VII-16 (3d ed. 1994). A showing of "need" has been supplanted, and the scope of expert testimony significantly broadened. The new standard requires only that the testimony "assist the trier of fact."

[4] By framing the admissibility determination in terms of Rule 703 rather than Rule 702, the Court's focus appropriately remains on the foundation underlying the witness's testimony. If, as the Court insists, courts must determine the scientific reliability of proffered testimony based on the underlying methodology, they certainly should not attempt to perform that task unaided by other expert testimony, as the trial court apparently did here. Appropriately viewed, the trial court's task becomes one of determining whether the methodology upon which an expert's testimony is based is of a type reasonably relied upon in the relevant scientific community. Because Rule 703 specifically addresses the permissible bases for expert opinions, courts should evaluate methodology only in that context. Instead, the Court once again simply follows wherever *Daubert's* dicta may lead. Not only is there no textual support in Rule 702 for this approach, this analysis disregards the role of Rule 703 in determining the appropriate bases for expert testimony.

[5] Rule 705, however, eliminates the need for hypothetical questions inasmuch as the expert need not state, before tendering an opinion, the facts or data underlying that opinion.

[6] In planning this study, Dr. Whitcomb hypothesized that Benlate had been contaminated during the manufacturing process with, among

other things, sulfonylurea herbicides, and that the herbicide contaminant damaged the Robinsons' pecan trees. To test his hypothesis, Dr. Whitcomb tested Benlate on a variety of plants and trees, controlling the environment to reduce the likelihood of other causes of differences between plants. Each plant was planted in the same type of pot, the same soil, and subjected to identical watering, light, and temperature. They were segregated from each other so that the likelihood of airborne contaminants was reduced.

Benlate was administered to the plants by three methods: spray, drench, and soil treatment. Doses were administered according to a random assignment, and each test was duplicated four times. For comparison, Dr. Whitcomb maintained a control group, that is, a group of untreated plants. See Rodricks, *Calculated Risks: The Toxicity and Human Health Risks of Chemicals in Our Environment* 124-26 (describing such methodology as a cohort study). Following the application of Benlate, Dr. Whitcomb compared the plant symptoms observed in the test with those observed on sites with Benlate problems and those associated with sulfonylurea herbicides. The symptoms he observed were similar to those he found described in professional journals and publications from around the world, as well as in DuPont's own documents. Based on his comparisons, he opined that common symptoms were exhibited. The only common denominator was the use of Benlate 50 DF. Dr. Whitcomb testified that the methodology he utilized in this study is widely used in the field of science generally, and particularly in the field of medicine, in the diagnosis of disease.

[7] As was the case with expert testimony based on personal observations, DuPont has apparently utilized similar tests to the ones employed by Dr. Whitcomb in its internal investigation of Benlate. Although the record contains several internal DuPont memoranda with indirect references to such tests, it is not clear whether DuPont intended to introduce any expert opinions based on these tests.

[8] The Supreme Court has noted: "Scientific methodology today is based on generating hypotheses and testing them to see if they can be falsified; indeed, this methodology is what distinguishes science from other fields of human inquiry." Daubert, 509 U.S. at 593, 113 S.Ct. at 2796 (quoting Green, *Expert Witnesses and Sufficiency of Evidence in Toxic Substances Litigation: The Legacy of Agent Orange and Bendectin Litigation*, 86 Nw.U.L.Rev. 643, 645 (1992)).

[9] This dilemma is further complicated by the fact that scientific inquiry, even at its best, does not always provide conclusive support for accepted scientific "truths." See Posner, *The Problems of Jurisprudence* 62 (1990). When scientists themselves cannot truly prove their theories through objective inquiry, we can hardly expect judges to reach objective, informed decisions on which theories are "reliable."

[10] Assuming *arguendo* that *Daubert's* standard would be appropriate in this case, I believe that Dr. Whitcomb's testimony would satisfy the four criteria set out by the Supreme Court: falsifiability, peer review, error rate, and general acceptance. First, Dr. Whitcomb's theories are certainly falsifiable. He set forth the procedures used in his Comparative Symptomology Study in great detail; DuPont could repeat such tests and thereby falsify or confirm his results. Second, Dr. Whitcomb's opinions were based, in part, upon conclusions that had been subjected to peer review. His own test results were subjected to limited review by Dr. Warde and Dr. Madden. Furthermore, Dr. Whitcomb relied upon several articles that were published in peer-reviewed journals. See, e.g., Blair & Martin, *A Review of the Activity, Fate and Mode of Action of Sulfonylurea Herbicides*, 22 PESTICIDE SCI. 195 (1988). Third, Dr. Whitcomb's study had a calculated rate of error that was well within acceptable ranges. Finally, the basic hypothesis—that Benlate was causing damage to various crops—while not proven conclusively, had gained a level of general acceptance among the scientific community. The Environmental Protection Agency was reviewing the potential contamination of Benlate and its effects on agricultural production. See *DuPont Pesticide Benlate Under Widespread Scrutiny*, Trial, Mar. 1993, at 104. The Florida Department of Agriculture and the University of Florida were also conducting tests. See Lyons, *DuPont Changes Course in Court*, NAT'L L.J., Mar. 7, 1994, at 1, 40. Even DuPont had devoted \$12 million and hired 100 scientists to research the issues. Because Dr. Whitcomb's methods satisfy the *Daubert* criteria, I believe the trial court erred, even under the standard adopted by the Court today.

[11] The Court misses the point of this argument, explaining, "Once the party opposing the evidence objects, the proponent bears the burden of demonstrating its admissibility." 923 S.W.2d at 557. In this case, the Robinsons responded to DuPont's objection, in part, by offering evidence in a bill of exceptions. In this proffer of evidence, Dr. Whitcomb explained in great detail the bases for his testimony, testifying that these were well-established scientific methods. Specifically, he testified that "comparative symptomology, [was] an approved scientific procedure reasonably relied upon by experts in [horticulture] and other fields in forming opinions." He characterized his research techniques as "sound, statistical, and scientific," whereby "plant response was evaluated quantitatively, ... and the resulting data ... was subjected to analysis of variance and other statistical analysis." Obviously, this evidence went far beyond the "bald assertion of validity" criticized in *Daubert* by the Ninth Circuit on remand. See Daubert v. Merrell Dow Pharmaceuticals, Inc., 43 F.3d 1311, 1316 (9th Cir.1995). Under Texas law, the expert's own testimony is sufficient to demonstrate the permissibility of the bases for the proffered opinions. See Lipsey v. Texas Dept. of Health, 727 S.W.2d 61, 72 (Tex.App.—Austin 1987, writ ref'd n.r.e.); St. Paul Med. Ctr. v. Cecil, 842 S.W.2d 808, 815 (Tex.App.—Dallas 1992, no writ).

When such evidence is presented, the proponent has carried its burden of demonstrating the admissibility of the witness's testimony, and in the absence of controverting evidence, the expert's opinion must be admitted.

[12] DuPont's counsel did argue that comparative symptomology was not a scientific method reasonably relied upon by experts in the

field, but this is not evidence, and did not satisfy DuPont's burden under Rule 104(a).

[13] See, e.g., Spence v. State, 795 S.W.2d 743, 752 (Tex.Crim.App.1990), cert. denied, 499 U.S. 932, 111 S.Ct. 1339, 113 L.Ed.2d 271 (1991) (bitemark evidence admitted); Reed v. State, 644 S.W.2d 479, 482 (Tex.Crim.App.1983) (amytol sodium test rejected); Crawford v. State, 617 S.W.2d 925, 930 (Tex.Crim.App.1980) (polygraph results rejected); Wilson v. State, 697 S.W.2d 83, 84 (Tex.App.—El Paso 1985, pet. ref'd) (enzyme multiplied immunoassay technique to detect controlled substance rejected); Sosa v. State, 841 S.W.2d 912, 916-17 (Tex.App.—Houston [1st Dist.] 1992, no pet.) (graphoanalysis rejected).

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